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A Portable Chunking Machine

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ABSTRACT.—A prototype, portable spiral-head shearing machine, designed to operate from the power take-off of an agricultural tractor, was fabricated. This spiral-head chunking concept offers an alternative to regular chipping, enhancing the prospect of using small-diameter wood for fiber or fuel. The potential exists for producing a commercial spiral-head chunking device patterned very closely after the prototype unit.

KEY WORDS: *comminution, energy, flakeboard, fuelwood, logging mechanism, chipping.*

Research conducted to find more efficient and effective ways to reduce wood residues to usable particles has led to the development of a unique, portable spiral-head shearing machine. Originally developed for producing chunkwood for flakeboard processes, its most immediate promise is for producing fuelwood. This wood chunking machine (patented by the Forest Service for public use) provides many advantages over conventional chipping processes. The large chunks it produces are ideal fuelwood for solid fuel industrial combustors and raw material for particleboard. It is also simpler, more compact, more energy efficient, and less costly to manufacture and operate than conventional chippers.

Internationally, there is growing interest in using wood fuel in stoker-fired residential and small-scale

industrial combustors to provide energy for individual farm residences, small farming or rural communities, schools, and small businesses. Although it is technically possible to stoker feed and burn pulp-size (1-inch) chips, they are not ideal for industrial-scale solid fuel combustors or gasifiers.

To demonstrate this chunking concept and its market potential for producing chunkwood for fuel from small diameter trees and residues, a small, prototype, portable spiral-head chipper was designed and built.

This small, portable spiral-head chipper would be a useful, inexpensive tool for farmers who own small woodlots and use wood for heating. The device, when coupled to a farm tractor, reduces forest thinnings into fuel chunks for individual farms and other energywood markets.

Production of the spiral-head chipper would create new jobs in both manufacturing and forest management activities. It is recommended that U.S. equipment manufacturers consider the potential of this unique machine. In Scandinavia and in parts of Europe, almost 1,000 similar machines have been built and sold under a European patent.

This note describes the U.S. prototype chipper and presents brief operating and performance data.

Description and Operation

The 625-pound spiral-head shearing unit mounts on the three-point hitch mechanism of an agricultural tractor. It fits either a category one or two hitch and should operate

from a 540-rpm power take-off (PTO) rated at 75 hp or more.

A 3/16-inch-thick cutter is attached to an 8-5/8-inch diameter shaft in a helical or spiral fashion, somewhat resembling a screw (fig. 1). This hub-mounted helicoid cutter has a lead of 2-7/8 inches and a total flight angle

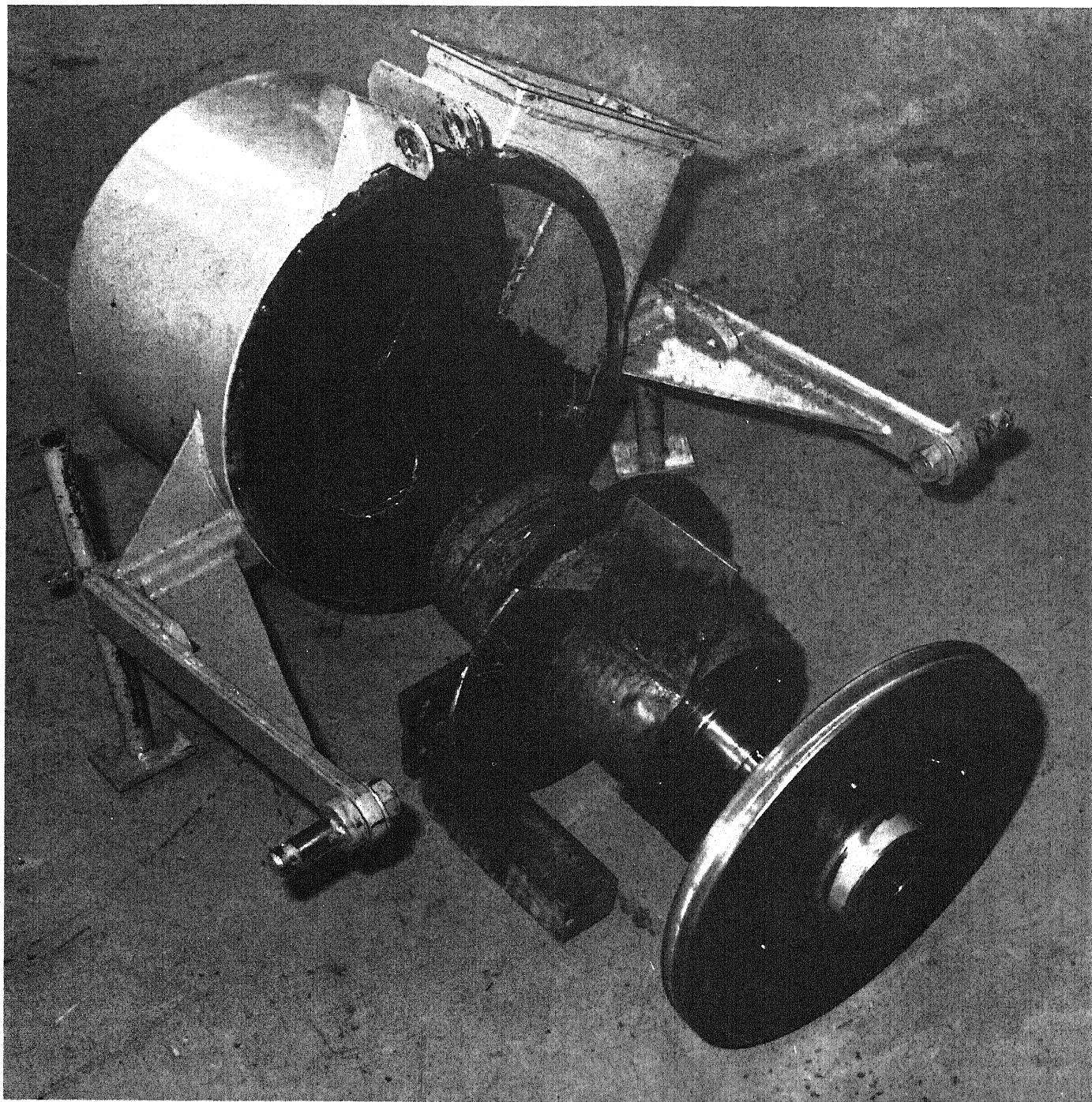


Figure 1.—Portable spiral-head chunking machine disassembled. F-531824

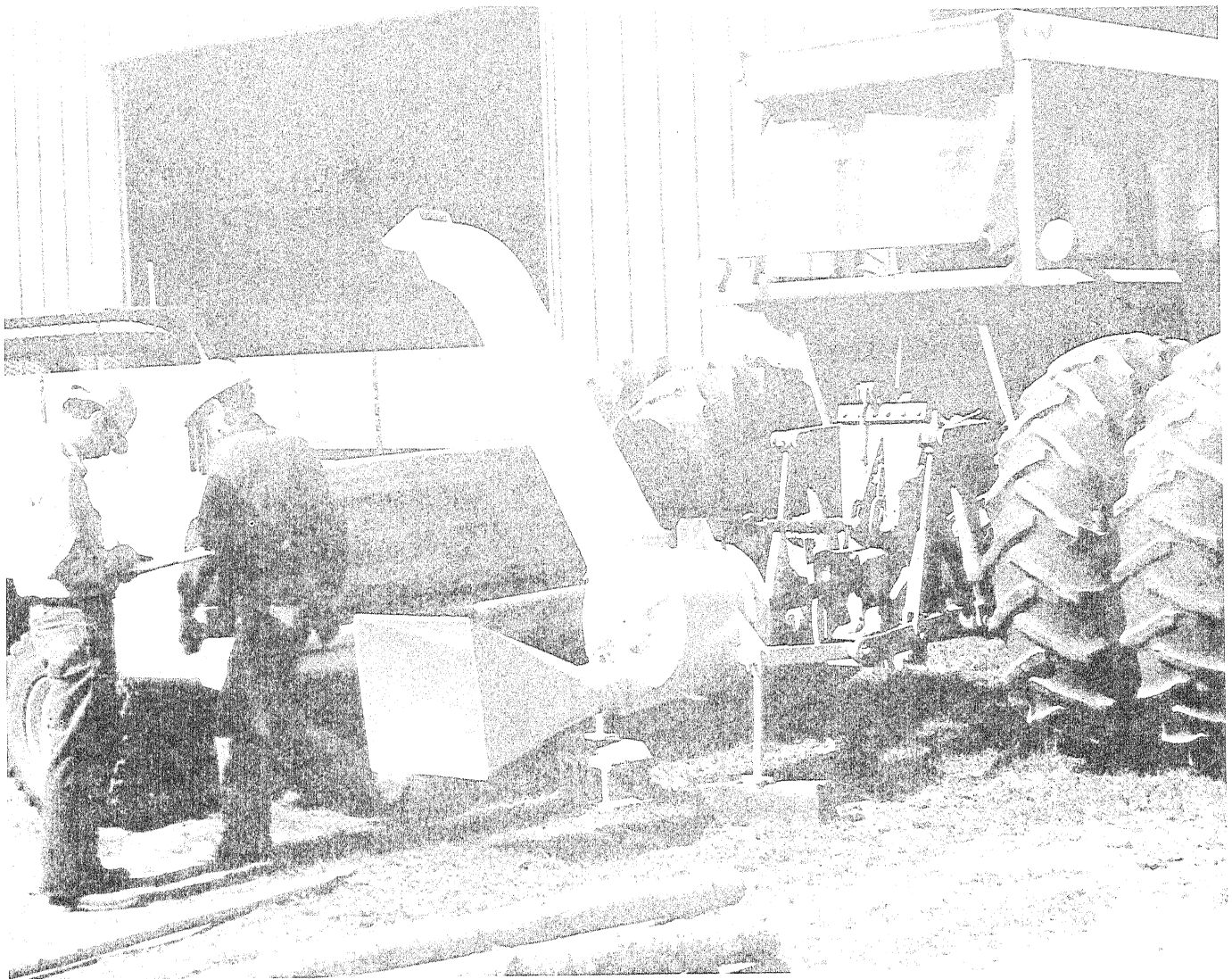


Figure 2.—Spiral-head chunking machine coupled to a 100-hp Massey Ferguson Model 1105 agricultural tractor. F-531825

of 420 degrees. It progressively increases in cutter depth from zero at the beginning to 5-1/2 inches, the maximum diameter of cut, at the end. The cutter is sharpened on both sides to an approximately 60-degree included angle. As the PTO-driven shaft rotates, the spiralling blade engages and slices through the log. This self-feeding device pulls the logs into the unit and cuts the blocks to predetermined length. (It will not feed entire trees with large, heavy limbs.) Attached to the same shaft, aft of the cutter, are two paddles that kick the individually severed blocks up and out of the outlet chute. The unit also has a small flywheel. The whole assembly is encased in a small drum-shaped shroud, 19-1/2 inches wide and 14-1/2 inches deep.

Description of Testing

Two series of tests were run to observe the chipper's performance and to determine its productive capabilities. Some straight, cleanly delimbed, 8-foot, small-diameter aspen bolts were selectively cut and sorted into two diameter classes: 2 to 3 inches and 4 to 5 inches. All logs were measured and weighed before testing. For these tests, the cutting device was directly coupled to the PTO of a 100-hp Massey Ferguson Model 1105¹ tractor (fig. 2).

¹ Mention of trade names does not constitute endorsement by the USDA Forest Service.

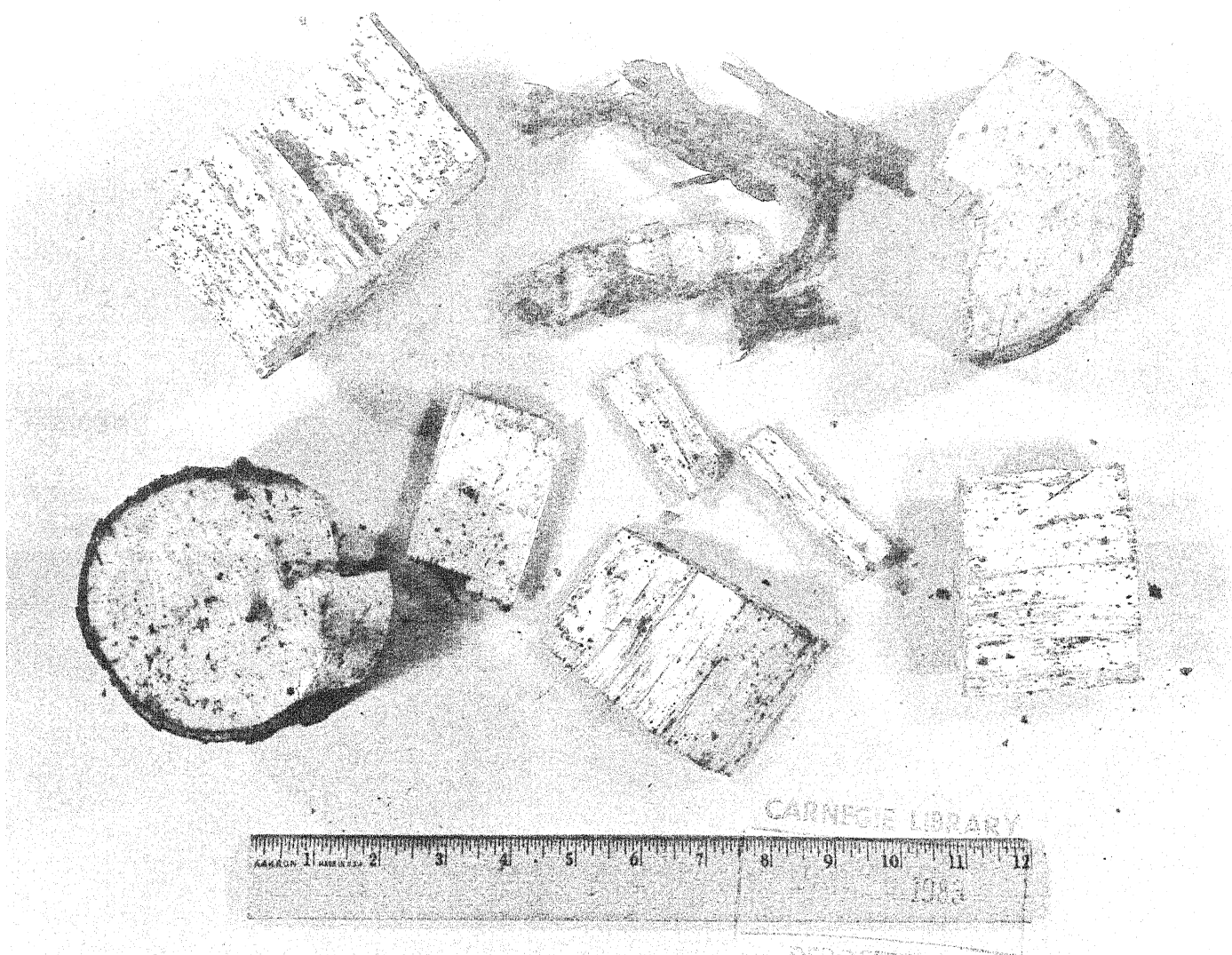


Figure 3.—Typical chunkwood output. F-531826

The PTO speed was set using a hand-held tachometer. All production data were adjusted to a 540-rpm level to facilitate comparisons. Logs within each diameter class were fed into the unit continuously (end to end), and a stop watch was used to determine cutting times. Bulk densities were determined by recording the weight of the chipper output and by measuring volume in a calibrated box. The results are summarized as follows:

2- to 3-inch diameter wood

Average stem diameter: 2.3 inches with 0.4-inch standard deviation.

Total weight of aspen chipped: 184 pounds.

Chipping rate: 6.0 tons/hour (adjusted to 540 rpm).

Chunkwood bulk density: 24 lb/ft³ (green weight).

4- to 5-inch diameter wood

Average stem diameter: 4.3 inches with 0.5-inch standard deviation.

Total weight of aspen chipped: 659 pounds.

Chipping rate: 17.8 tons/hour (adjusted to 540 rpm).

Chunkwood bulk density: 27 lb/ft³ (green weight).

The chunking particles produced (fig. 3) averaged about 2.7 inches long in the fiber direction and ranged in cross section from finger size up to the full diameter of the small bolts that were chunked.